# AI & Robotics in Healthcare :
# A Challenge in Ethics & Laws

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# The rise of Robotics and AI

Fueled by advances in computing power and connectivity, the fields of robotics and artificial intelligence have grown rapidly

**1921**
The term **robot** is first used by Czech writer Karel Capek

**1939**
**Elektro**, a humanoid robot, debuts at the World's Fair, smoking cigarettes and blowing up balloons

**1948**
William Grey Walter creates the first **autonomous robot** with complex behavior

**1941**
Isaac Asimov formulates the

## Three Laws of Robotics:

**A robot may not injure a human being** or, through inaction, allow a human being to be harmed

**A robot must obey orders** given it by human beings except where such orders would conflict with the First Law

**A robot must protect its own existence** as long as such protection does not conflict with the First or Second Law

**1950**
Alan Turing publishes paper about the possibility of machines that think, develops idea known as the

## Turing's Test.

It tests a machine's ability to "think" by answering a series of questions. In essence, the tester must think the machine's answers are coming from a human

**1951**
Marvin Minsky builds the first neurocomputer, **SNARC**

**1954**
George Devol invents the first digitally operated and programmable robot

**1956**
Field of AI research founded at a conference at Dartmouth

**1960**
Frank Rosenblatt constructs **Mark I Perceptron**, a computer that learned new skills by trial and error

**1961**
**GM installs Unimate** robot to lift and stack hot pieces of metal

**1968**
Mobile robot **"Shakey"** is introduced. It's controlled by a computer the size of a room

**1972**
Stanford researcher develops **PARRY**, designed to simulate a paranoid schizophrenic.

How are you feeling today?

I have had enough of this.

**1974**
Intel produces its second-generation 8080 general-purpose chips

**1979**
**SCARA**, an articulated robot arm, is developed for assembly lines

**1984**
Doug Lenat and his team start **Cyc**, to codify millions of pieces knowledge that compose human common sense

**1984**
The **RB5X**, developed by General Robotics Corp., includes software enabling it to learn from its environment

**1985**
Jaron Lanier's VPL Research, Inc., sells first VR glasses and gloves; Lanier coins the phrase

## virtual reality

**1986**
Honda creates the **E0**, the first of a series of humanoid robots that walk on two feet

**1988**
The first **HelpMate** service robot begins work at Danbury Hospital

**1988**
Researchers launch **Jabberwacky**, an AI chatbot designed to learn through conversation

Nope, I'm human.

**1956**
IBM 305, the first hard disk drive
**5MB**

**1970**
IBM 1330
**100MB** per pack

**1985**
IBM 0665, a 5.25" disk with
**20-40MB**

## Minimize and maximize
Shrinking disk sizes and exponentially growing capacity help fuel robotics and AI

# Robotics and AI charging forward

With technologies advancing at breakneck speeds, robotics and artificial intelligence are finding new applications in factories, businesses, and homes

**1990**
Tom Caudell coins the phrase **augmented reality**

**1990**
iRobot® Corporation is founded, producing domestic and military robots

**1997**
Deep Blue defeats Garry Kasparov in a game of chess

**1997**
NASA's Pathfinder lands on Mars

**1998**
Dr. Cynthia Breazeal creates Kismet, a robot that interacts emotionally with humans

**2000**
The UN estimates there are 742,500 industrial robots in use worldwide

**2005**
Stanford robot Stanley drives autonomously for 131 miles

**2006**
IBM introduces Watson, a question-answering computer system that later defeated a Jeopardy! champion

**2007**
Fanuc develops an industrial robot arm that can grab 120 items per minute

**2010**
Google launches a 3D version of its Street View

**2011**
Siri is introduced

**2012**
Google introduces its Siri response: Google Now, which already has been rendered obsolete by Google Assistant

**2012**
Baxter, created by Rodney Brooks, can do light repetitive tasks

**2012**
An estimated 8.7 billion devices are connected to the internet

**2013**
Google launches Google Glass, augmented reality glasses

**2015**
Amazon launches Alexa, a "virtual assistant" that helps communicate with connected devices in the home

**2016**
Amazon makes first drone delivery in UK

**2016**
Sony PlayStation launches PlayStation VR

**2016**
Uber begins testing driverless cars in California and Arizona

**2016**
Companies utilize an estimated 1.8 million industrial robots

**2020**
By 2020, the drone industry could be worth **$127 billion**

The FAA expects 7 million drones to ship in the US, including 2.7 million commercial drones

## Growing capacities
As disk size has shrunk, capacity has grown exponentially since 2000

| 2004 | 2015 | 2025 |
|---|---|---|
| Seagate ST1, 1" disk | Seagate Thin HDD, 2.5", 7mm thick | Even smaller 100+ TB? |
| 2.5–5GB | 2 TB | |

## Industrial robots: looking forward
A common fixture in the factory, the industrial robot has reshaped the manufacturing landscape through the years by performing duties unsuitable for humans

- 2005 — Fewer than 1 million
- 2016 — 1.8 million
- 2019 — 2.6 million
- 2034

Robotics and other computerization could replace **47 percent of U.S. jobs**, according to a 2013 University of Oxford study

pwc

**14.6** USD BILLION 2023-e

**102.7** USD BILLION 2028-e

**CAGR** of **47.6%**

The AI in Healthcare market is estimated to reach USD 102.7 billion by 2028, registering a CAGR of 47.6% from 2023 to 2028.

North America accounted for the largest share of 47.6 % of the AI in healthcare market in 2022.

NORTH AMERICA

The availability of big data and the demand to reduce healthcare cost are expected to drive the growth of the market during the forecast period.

Product launches would offer lucrative opportunities for market players in the next five years.

The market for machine learning technology is expected to grow at the highest CAGR of 47.6 % during the forecast period.

The market growth in Asia Pacific can be attributed to the increasing use of AI in the healthcare sector, as well as increasing government investments in the healthcare sector in this region.

StartUs insights

**5116**
STARTUPS ANALYZED

# Global Startup Heat Map: Digital Health
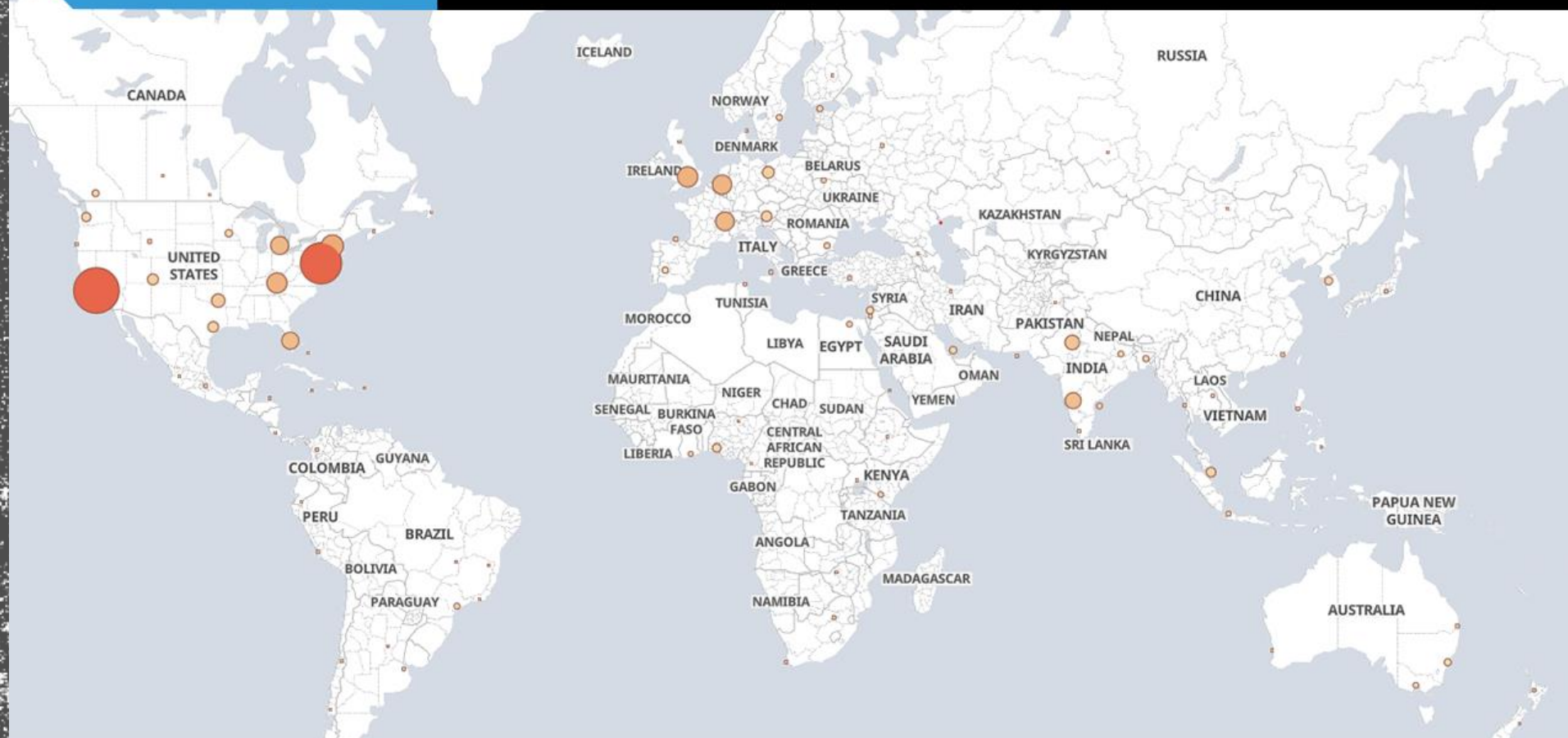
This Global Startup Heat Map illustrates the geographical distribution of 5116 startups & emerging companies we analyzed for this topic. Data from April 2023.

# Impact of Top 10 Digital Health Trends

Digital Health

Healthcare Analytics — SHILLING, NXG

Cloud Healthcare — aurabox, MITER HEALTH

Electronic Health Records — CLOUDPITAL, z-waka

Medical Wearables — silvertree, InHandPlus

Remote Patient Monitoring — TELOS HEALTH SOLUTIONS, ACCESS TELEHEALTH

Digital Therapeutics — tesu, ATX THERAPEUTICS

Patient Engagement — nilo, Siara Health

Home Health Care — MEDpath, axle HEALTH

Digital Biomarkers — lapsi, IMVARIA

Mobile Health — Brea, exakt health

## 5116
Startups & emerging companies analyzed
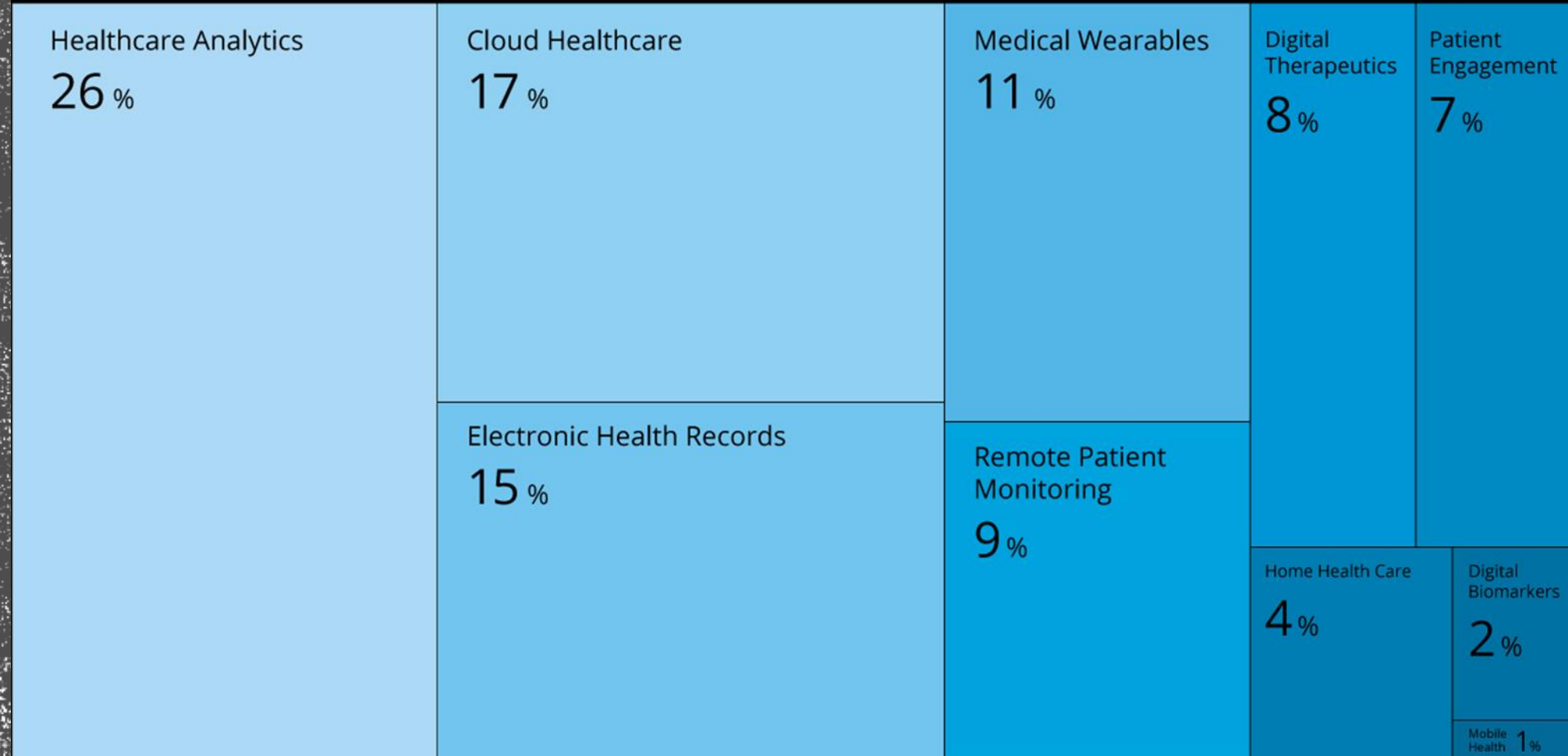
Data provided by StartUs insights — April 2023

# Impact of Top 10 Digital Health Trends

Healthcare Analytics
26 %

Cloud Healthcare
17 %

Electronic Health Records
15 %

Medical Wearables
11 %

Remote Patient Monitoring
9 %

Digital Therapeutics
8 %

Patient Engagement
7 %

Home Health Care
4 %

Digital Biomarkers
2 %

Mobile Health 1 %

# Top 10 Digital Healthcare Trends to Look Out for in 2023

| | | |
|---|---|---|
| **AI-enabled Transformation** | **Wearable tech and Continuous Health Monitoring** | **Better Privacy and Security** |
| **Smart Implants** | **Augmented Reality and Virtual Reality** | **Nanomedicine** |

| | |
|---|---|
| **Universal Adoption of Telehealth** | **Use of Big Data and Analytics** |
| **Social Determinants of Health (SDOH) and Healthcare Inequality** | **Importance of adopting digital healthcare** |

Thailand Health Tech Startup Ecosystem

94 Healthtech Startups
Version 2.1, June 2023
www.thaihealthtech.com

Assisted or automated diagnosis & prescription

Real time case prioritization and triage

Personalized medications and care

Patient data analytics

Pregnancy Management

Diagnostic error prevention

Medical imaging insights

Early diagnosist

PATIENT CARE

MEDICAL IMAGING AND DIAGNOSTIC

AI Multiple

HEALTHCARE

RESEARCH AND DEVELOPMENT

MANAGEMENT

Drug discovery

Gene analytics and editing

Device and drug comparative effectiveness

Market research

Pricing and risk

Brand management and marketing

NOT INTENDED FOR USE IN PRIMARY DIAGNOSIS

# AI FOR DIGITAL PATHOLOGY

"Computational Pathology"
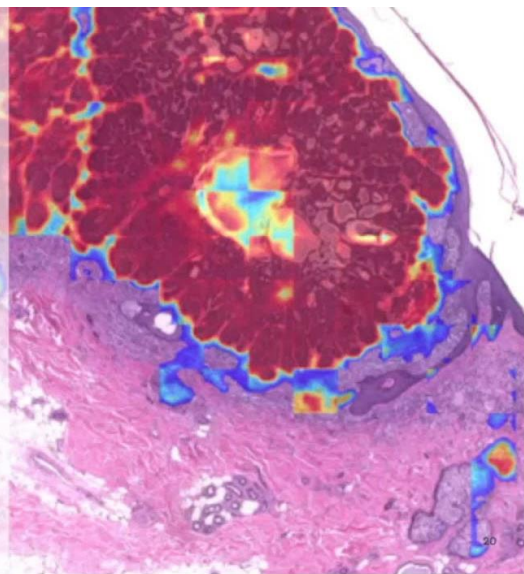
## NYU open-sources breast cancer screening model trained on over 200,000 mammography exams

Kyle Wiggers    @Kyle_L_Wiggers    March 21, 2019 8:30 AM    AI

IDTechEx Research
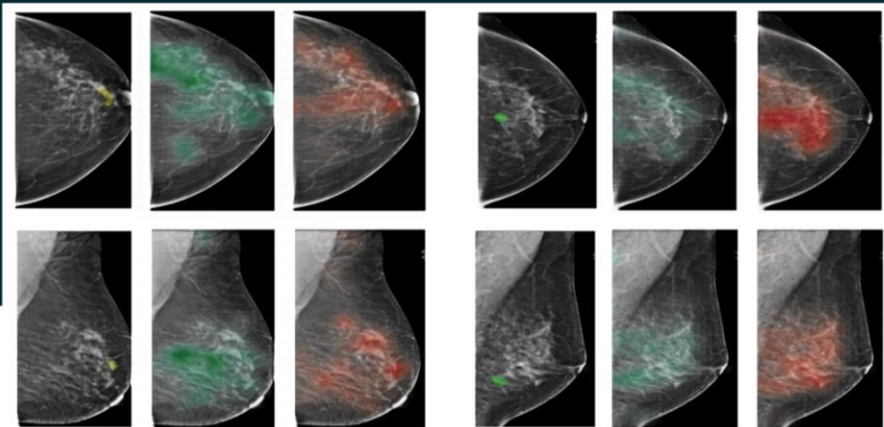
### AI in Medical Diagnostics 2020-2030: Image Recognition, Players, Clinical Applications, Forecasts

*Benchmarking 60+ companies for image recognition AI performance, market readiness, value proposition, technical maturity and more. Granular forecasts for 12 clinical applications, insights into addressable market size and penetration until 2030.*

Dr Ivan De Backer, Dr Khasha Ghaffarzadeh and Dr Nadia Tsao

www.IDTechEx.com
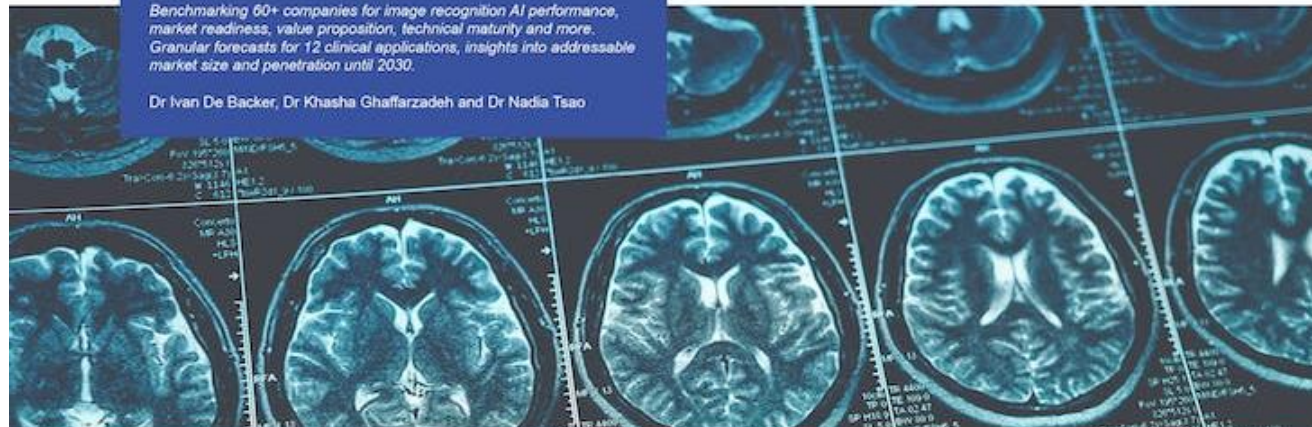
# Currently Uses AI / Robotic in Medicine

- Many doctors use electronic health records (EHRs) with integrated AI that include computerized clinical decision support tools designed to reduce the risk of diagnostic error and to integrate decision-making in the medication ordering function.

- Cardiologists, pathologists, and dermatologists use AI in the interpretation of vast amounts of images, tracings, and complex patterns.

- Surgeons are using AI-enhanced surgical robotics for orthopedic surgeries, such as joint replacement and spine surgery.

- A growing number of doctors are using ChatGPT to assist in drafting prior authorization letters for insurers. Experts say more doctors are also experimenting with ChatGPT to support medical decision-making.

- Within oncology, physicians use machine learning techniques in the form of computer-aided detection systems for early breast cancer detection.

- AI algorithms are often used by health systems for workflow, staffing optimization, population management, and care coordination.

- Some systems within EHRs use AI to indicate high-risk patients.

- About 30% of radiologists use AI in their practice to analyze x-rays and CT scans.

- Epic Systems recently announced a partnership with Microsoft to integrate ChatGPT into MyChart, Epic's patient portal system. Pilot hospitals will utilize ChatGPT to automatically generate responses to patient-generated questions sent via the portal.

Lawsuit against over AI misuse

**Sarah Silverman is suing OpenAI and Meta for copyright infringement**

/ The lawsuits allege the companies trained their AI models on books without permission.

By Wes Davis, a weekend editor who covers the latest in tech and entertainment. He has written news, reviews, and more as a tech journalist since 2020.

Jul 10, 2023, 1:14 AM GMT+7 | 142 Comments / 142 New

Comedian and author Sarah Silverman, seen here participating in a Tax Day protest in 2017. Photo by Stephanie Keith/Getty Images



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*Counsel for Individual and Representative Plaintiffs and the Proposed Class*

**UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION**

SARAH SILVERMAN, an individual;
CHRISTOPHER GOLDEN, an individual;
RICHARD KADREY, an individual;

Individual and Representative Plaintiffs,

v.

OPENAI, INC., a Delaware nonprofit corporation; OPENAI, L.P., a Delaware limited partnership; OPENAI OPCO, L.L.C., a Delaware limited liability corporation; OPENAI GP, L.L.C., a Delaware limited liability company; OPENAI STARTUP FUND GP I, L.L.C., a Delaware limited liability company; OPENAI STARTUP FUND I, L.P., a Delaware limited partnership; and OPENAI STARTUP FUND MANAGEMENT, LLC, a Delaware limited liability company,

Defendants.

Case No.

COMPLAINT

CLASS ACTION

DEMAND FOR JURY TRIAL

The complaint lays out in steps why the plaintiffs believe the datasets have illicit origins — in a Meta paper detailing LLaMA, the company points to sources for its training datasets, one of which is called ThePile, which was assembled by a company called EleutherAI. ThePile, the complaint points out, was described in an EleutherAI paper as being put together from "a copy of the contents of the Bibliotik private tracker." Bibliotik and the other "shadow libraries" listed, says the lawsuit, are "**flagrantly illegal**."

In both claims, the authors say that they "**did not consent to the use of their copyrighted books as training material**" for the companies' AI models. Their lawsuits each contain six counts of various types of copyright violations, negligence, unjust enrichment, and unfair competition. The authors are looking for statutory damages, restitution of profits, and more.

# Judge rules that AI-generated art isn't copyrightable, since it lacks human authorship

An attempt to overturn a US Copyright Office decision was rejected.

**Kris Holt**
Contributing Reporter
Mon, Aug 21, 2023, 10:00 PM GMT+7 · 2 min read



Stephen Thaler/Creativity Machine

**A federal judge has agreed with US government officials that a piece of artificial intelligence-generated art isn't eligible for copyright protection in the country since there was no human authorship involved.**

"Copyright has never stretched so far [...] as to protect works generated by new forms of technology operating absent any guiding human hand, as plaintiff urges here," Judge Beryl Howell of the US District Court for the District of Columbia wrote in the ruling, which The Hollywood Reporter obtained. "Human authorship is a bedrock requirement of copyright."

Dr. Stephen Thaler sued the US Copyright Office after the agency rejected his second attempt to copyright an artwork titled "**A Recent Entrance to Paradise**" in 2022. The USCO agreed that the work was generated by an AI model that Thaler calls the Creativity Machine. The computer scientist applied to copyright the work himself, describing the piece **"as a work-for-hire to the owner of the Creativity Machine."** He claimed that the USCO's "human authorship" requirement was unconstitutional.

A Recent Entrance to Paradise

**Claims and Litigation**

# Artificial intelligence in medicine creates real risk management and litigation issues

By Matthew P. Keris

**Abstract:** The next step in the evolution of electronic medical record (EMR) use is the integration of artificial intelligence (AI) into health care. With the benefit of roughly 15 years of electronic medical records (EMR) data from millions of patients, health systems can now leverage this historical information via the assistance of complex mathematical algorithms to formulate computer-based medical decisions. With AI spending in health care forecasted to increase from

## Can you sue an algorithm for malpractice? It depends

By Saurabh Jha   March 9, 2020

Reprints

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# A New Generation of Legal Issues Part 2: *First Lawsuits Arrive Addressing Generative AI*

**04.20.2023 | UPDATES**

This is the second of a three-part series on the hot legal topics surrounding generative artificial intelligence (AI) (see Part 1: *The Latest Chapter in Copyrightability of AI-Generated Works*).

As the quality of generative AI tools has soared, copyright and other intellectual property (IP) issues around generative AI tools have attracted increased attention. Some artists, creators, and performers have raised concerns about the use of their content or identity in connection with these technologies and fear that these technologies could in some sense replace them. Developers and users of these tools, however, point to their benefits, and the value of innovation, and highlight the need for access to broad data resources to facilitate that innovation. Now that the initial lawsuits involving these technologies have been filed, these issues may be addressed by the courts for the first time.

## The Cases Begin

**GitHub Copilot Lawsuit (Complaint)**

The first case to be filed involving generative AI is a class-action lawsuit filed in November against GitHub, Microsoft, and OpenAI, involving GitHub's Copilot tool. Copilot is an AI-powered tool that suggests new lines of code in real time based on what a programmer has already written. This case does not raise any copyright infringement claims, but instead focuses mostly on breach of contract and privacy-related claims. The plaintiffs allege that Copilot copies code from publicly available software repositories on GitHub without meeting the requirements of the open-source licenses applicable to such code (e.g., by failing to provide attribution, copyright notices, and a copy of the license terms, and by not making Copilot itself open source). The Complaint includes other claims, such as violation of 17 U.S.C. § 1202 for the alleged removal of copyright management information (CMI), claims relating to GitHub's handling of "personal data" and "personal information," a claim of wrongful interference with the plaintiff's business interests and expectations, and claims of fraud, false designation of origin, unjust enrichment, and unfair competition.

# Cases that have been brought against generative AI companies regarding copyright and misuse

## GitHub, Microsoft and OpenAI

A class-action suit was filed against these companies involving GitHub's Copilot tool. The tool predictively generates code based on what the programmer has already written. The plaintiffs allege that Copilot copies and republishes code from GitHub without abiding by the requirements of GitHub's open source license, such as failing to provide attribution. The complaint also includes claims related to GitHub's mishandling of personal data and information, as well as claims of fraud. The complaint was filed in November 2022. Microsoft and GitHub have repeatedly tried to get the case dismissed.



## Stability AI, Midjourney and DeviantArt

A complaint against these AI image generator providers was filed in January 2023. The plaintiffs alleged the systems directly infringe on plaintiffs' copyrights by training on works created by the plaintiffs and creating unauthorized derivative works. The complaint also takes issue with the fact that the tools can be used to generate work in the style of artists. The judge on the case, William Orrick, said he was inclined to dismiss the lawsuit.



## Stability AI

In January 2023, Getty Images issued a complaint against Stability AI for allegedly copying and processing millions of images and associated metadata owned by Getty in the U.K. Getty filed another lawsuit against Stability AI in the U.S. District Court for the District of Delaware days later, which raised many copyright- and trademark-related claims, and pointed to "bizarre or grotesque" generated images that contained the Getty Images watermark and, therefore, damaged Getty's reputation.

## OpenAI

Authors Paul Tremblay and Mona Awad are suing OpenAI for allegedly infringing on authors' copyrights. Butterick is one of the attorneys representing the authors. The complaint estimated that more than 300,000 books were copied in OpenAI's training data. The suit seeks an unspecified amount of money. The case was filed in June 2023.



## Meta and OpenAI

Sarah Silverman's lawsuit against Meta and OpenAI alleged copyright infringement and said ChatGPT and Large Language Model Meta AI (Llama) were trained on illegally acquired data sets with her work contained. The suit alleges the books were acquired from shadow libraries, such as Library Genesis, Z-Library and Bibliotek, where the books can be torrented. Torrenting is a common method of downloading files without proper legal permission. Specifically, Meta's language model, Llama, was trained on a data set called the Pile, which uses data from Bibliotek, according to a paper from EleutherAI, the company that assembled the Pile. The suit was filed in July 2023.
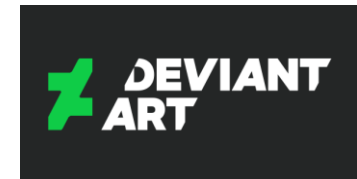


## Google

A class-action lawsuit is being brought against Google for alleged misuse of personal information and copyright infringement. Some of the data specified in the lawsuit includes photos from dating websites, Spotify playlists, TikTok videos and books used to train Bard. The lawsuit, filed in July 2023, said Google could owe at least $5 billion. The plaintiffs have elected to remain anonymous.

Could we Sue
Diagnostic Algorithms
Or Medical Robots
In The Future?

AI
AND
MEDICINE

- In 2030, John went to BKK for a check-up to his GP because he felt nauseated all the time and a strange pressure on the left side of his head.
- The doctor suggested to him that he runs a couple of tests and informed him about involving a diagnostic algorithm in the procedure.
- The machine learning algorithm was trained to identify brain tumors – one of the first studies in the area dates back to March 2018 – with very high accuracy. In most cases, it diagnosed cancerous tissues far better than some trained histopathologists, but in Andrea's case, something went astray.
- The algorithm found something different than the diagnostician, and as the use of A.I. was already common practice, the histopathologist did not question the judgment. As a result,

- John was mistreated: an unnecessary operation, ineffective medication cures and long-long weeks went by until someone discovered the algorithmic error.
- However, the patient's brain already suffered irreversible damages, and the family wants to sue.
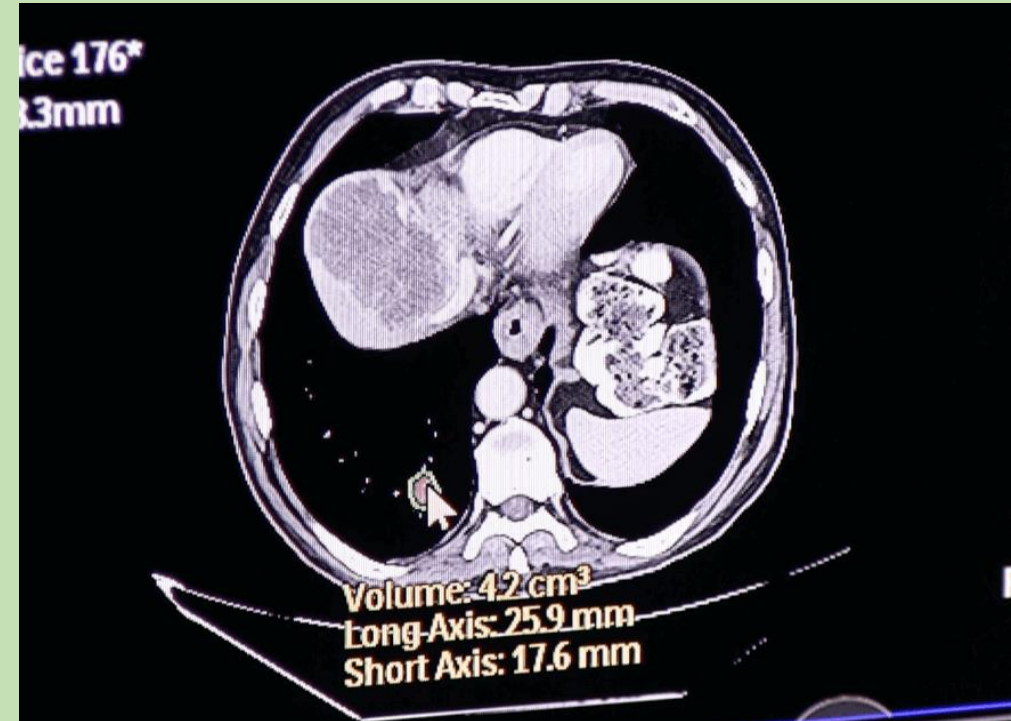
- In the 2040s, **the popularity of blood-drawing robots** soared as they were fast, efficient and they could find the appropriate vein usually in less time than nurses or phlebotomists.

- One morning, Greg went to the local hospital because he needed a blood test for checking on an infection. He already had some experience with blood-drawing robots, so he was aware that the procedure lasts less than a minute, and it is minimally painful.

- When Greg sat down, and the nurse turned on the system, the robotic arm found the vein and took the blood.
- However, afterwards, it did not respond to any command anymore leaving the needle in Greg's arm for long-long minutes. He was shocked.

- After the staff managed to remove it, his arm wound had to be bandaged.
- He decided to hire a medical malpractice lawyer. But whom to sue?
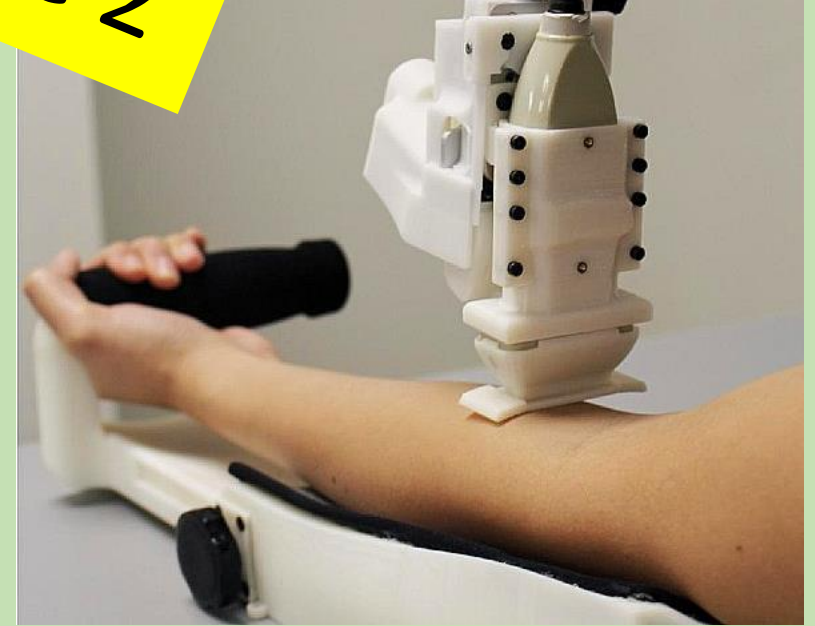
- ✓ **What if a deep learning algorithm misses a diagnosis, the doctor accepts the judgment and the patient dies??**
- ✓ **What if a surgical robot injures a patient during a procedure??**
- ✓ **Who will be held liable in the future when robots and artificial intelligence (A.I.)??**
- ✓ **What about the FDA already approved first A.I. diagnostic algorithms??**
- ✓ **Design flaws, Implementation flaws, and User error??**
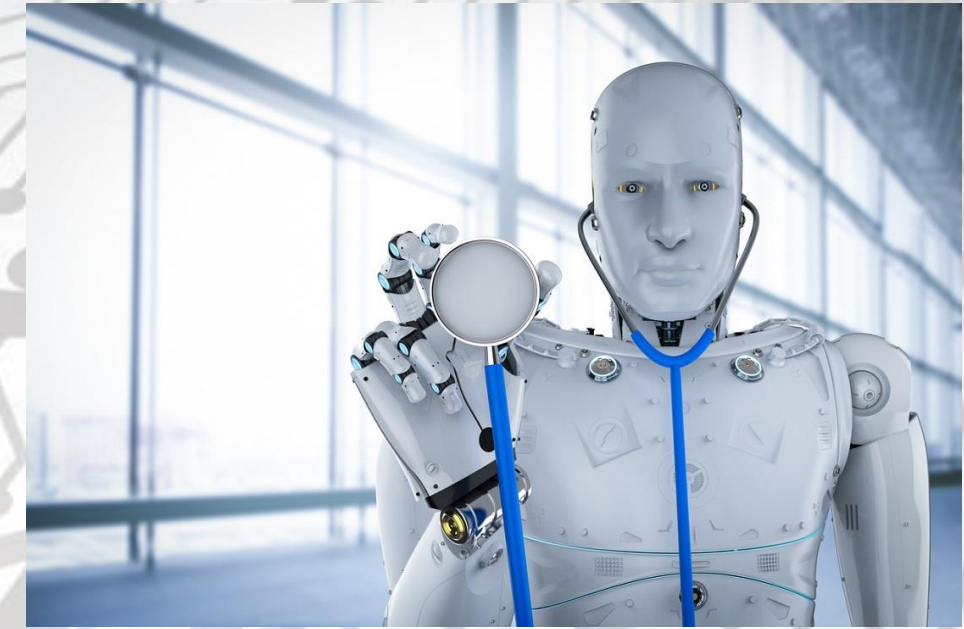
**lawmakers and medical malpractice lawyers should consider these scenarios as they might become reality sooner than expected**



Who do you think should be liable for the acts/ omissions/decisions of AI?

6% Don't know
3% AI system
17% Developer of the AI system
49% Joint liability
25% User of the AI system
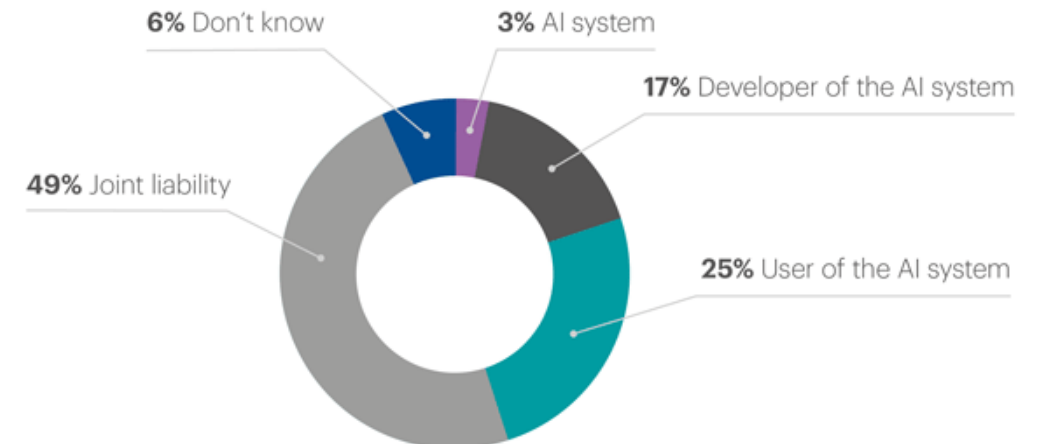
# ARTIFICIAL INTELLIGENCE VS DEEP LEARNING VS CONTINUOUS LEARNING

## Artificial intelligence
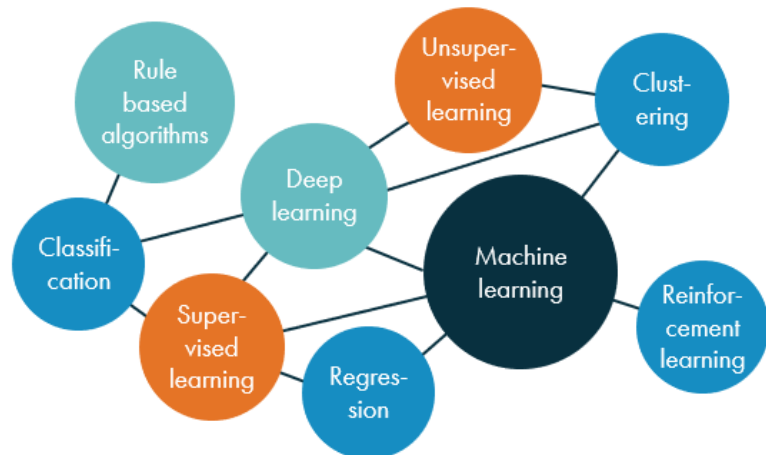


A whole bunch of different types of algorithms.

## Deep learning



*Fixed training dataset*
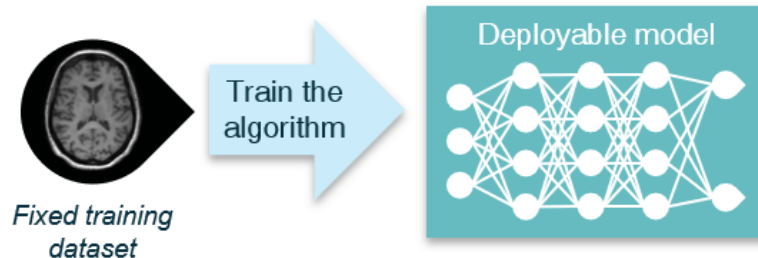
The common type of deep learning trains the algorithm on a fixed dataset, after which a model is ready to deploy.

## Continuous learning



*Initial training dataset*

*Added data over time*

*Model changes over time*
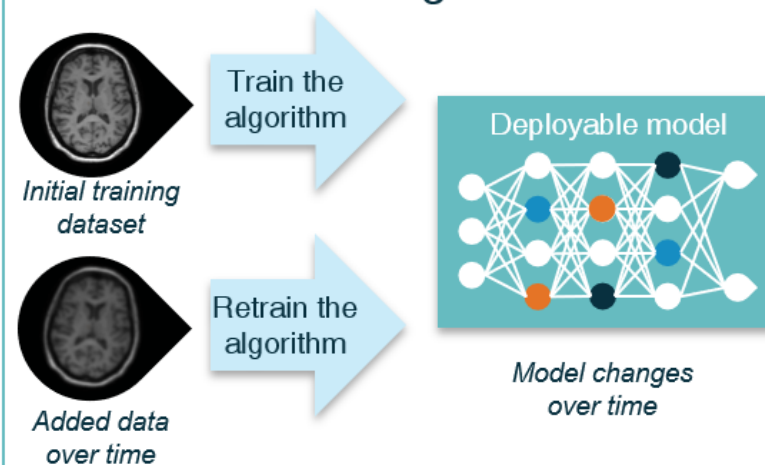
Over time new data is added to the algorithm changing the way the algorithm works.

Quantib

**Artificial Intelligence (AI)**
A process where a computer is trained to do a task in a way that mimics human behavior
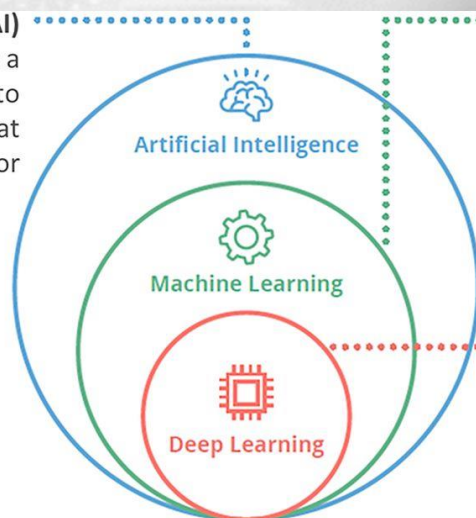
**Machine Learning (ML)**
Algorithms that allow computers to learn from examples without being explicitly programmed

Artificial Intelligence

Machine Learning

**Deep Learning (DL)**
A subset of ML that uses artificial neural networks as models and does not need feature engineering

Deep Learning
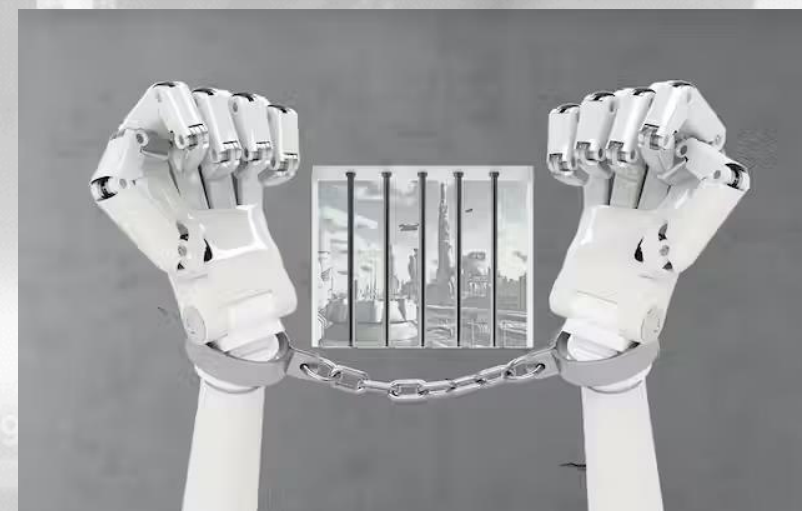
# Artificial Intelligence and Liability in Medicine : Balancing Safety and Innovation

GEORGE MALIHA, SARA GERKE, I. GLENN COHEN, RAVI B. PARIKH ✉

THE MILBANK QUARTERLY
A MULTIDISCIPLINARY JOURNAL OF POPULATION HEALTH AND HEALTH POLICY

- ✓ With increasing integration of artificial intelligence and machine learning in medicine, there are concerns that algorithm inaccuracy could lead to patient injury and medical liability.

- ✓ While prior work has focused on medical malpractice, the artificial intelligence ecosystem consists of multiple stakeholders beyond clinicians. **Current liability frameworks are inadequate** to encourage both safe clinical implementation and disruptive innovation of artificial intelligence.

- ✓ Several policy options could ensure a more balanced liability system, including altering the standard of care, insurance, indemnification, special/no-fault adjudication systems, and regulation. Such liability frameworks could facilitate safe and expedient implementation of artificial intelligence and machine learning in clinical care.

| Type of Liability (Definition) | Implications for Physicians | Implications for Developers or Health Systems |
|---|---|---|
| **Medical malpractice** (Deviating from the standard of care set by the profession) | Physicians may be liable for failing to critically evaluate AI/ML recommendations. This may change as AI/ML systems integrate into clinical care and become the standard of care. | Health systems or practices that employ or credential physicians and other health care practitioners may be liable for practitioners' errors ("vicarious liability"). |
| **Other negligence** (Deviating from the norms set by an industry and courts) | Physicians may be liable for (1) their decision to implement an improper AI/ML system in their practice, or (2) their employees' negligent treatment decisions related to AI/ML systems ("vicarious liability") | Hospital liability for negligent credentialing of physicians could extend to failure to properly assess a new AI/ML system. In general, health systems may be liable for failing to provide training, updates, support, maintenance, or equipment for an AI/ML algorithm. |
| **Products liability** (Designing a product that caused an injury) | Physicians might be involved in these cases if they work or consult for designers of AI/ML devices. | The law is unsettled in this area. As AI/ML software integrates into care or becomes more complex, algorithm developers may have to contend with liability. |

# Models of Liability in Artificial Intelligence and Machine Learning

- balancing liability across the ecosystem;
- avoiding undue burdens on physicians and frontline clinicians; and
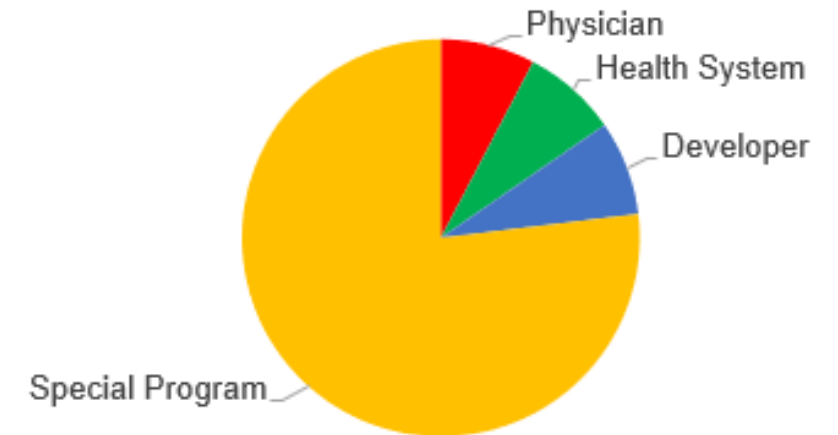- promoting safe AI/ML development and integration.

- the legal system must balance liability to promote innovation, safety, and accelerated adoption of these powerful algorithms.
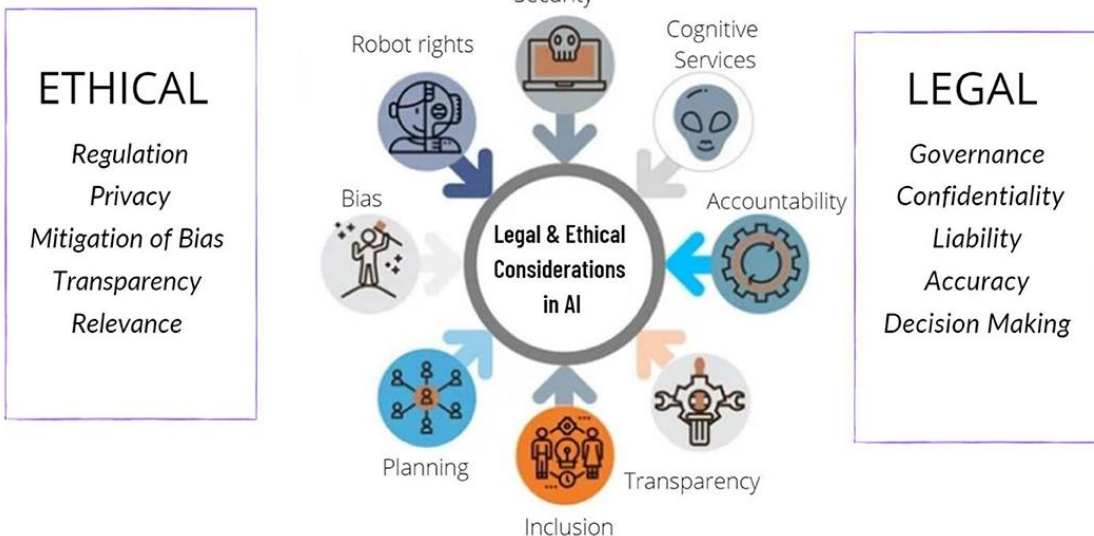


A. Traditional Liability (Base Case)

B. Risk Sharing
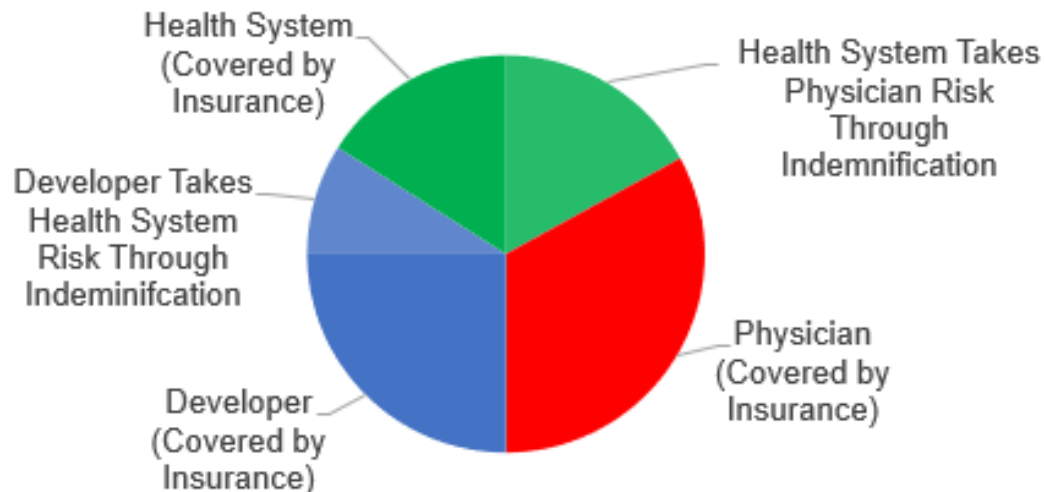
C. Special Compensation System

# Ethical Challenges in AI/ML Healthcare

**4 major ethical issues must be addressed**

1. **Informed consent to use data**
2. **Safety and Transparency**
3. **Algorithmic Fairness and Biases**
4. **Data privacy**



REPORT / STUDY | Publication 17 July 2020

## Assessment List for Trustworthy Artificial Intelligence (ALTAI) assessment

On the 17 of July 2020, the High-Level Expert Group on Artificial Intelligence (AI HLEG) presented their final Assessment List for Trustworthy Artificial Intelligence.

Following a piloting process where over 350 stakeholders participated, an earlier prototype of the list was revised and translated into a tool to support AI developers and deployers in developing Trustworthy AI.

Measure
if your organis
trustw

ALTAI – Assessment List for

**Related topics**

Artificial intelligence

Advanced Digital Technolog

1. human agency and oversight
2. technical robustness and safety
3. privacy and data governance
4. transparency
5. diversity, non-discrimination and fairness
6. environmental and societal well-being and
7. accountability

# Ethical Issues of Artificial Intelligence in Medicine and Healthcare

Dariush D. Farhud [1,2,3] and Shaghayegh Zokaei [3,4]

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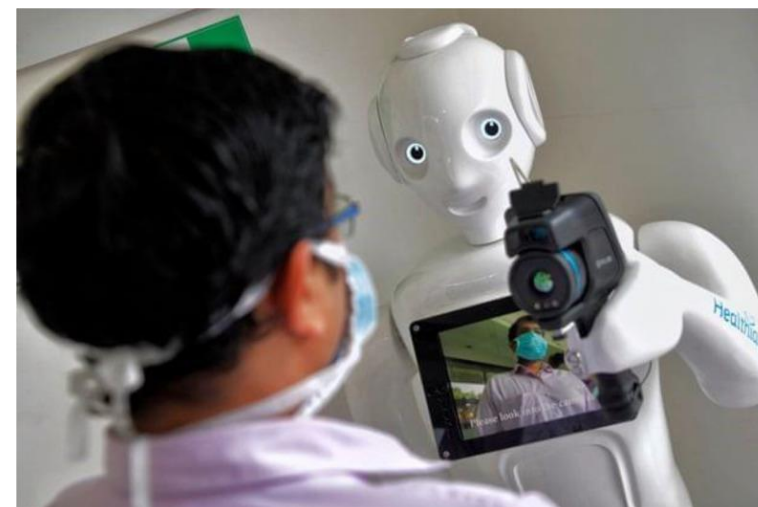
## Introduction

Go to: ▸

Artificial intelligence (AI) is a term applied to a machine or software and refers to its capability of simulating intelligent human behavior, instantaneous calculations, problem-solving, and evaluation of new data based on previously assessed data ([1]). AI heavily influences many industries and fields, including agriculture and farming, manufacturing and production, autonomous vehicles, fashion, sports analytics and activities, healthcare, and the medical system. This technology has the power to impact the future of the industry and human beings, but it is a double-edged sword.

AI applications in healthcare have literally changed the medical field, including imaging and electronic medical records (EMR), laboratory diagnosis, treatment, augmenting the intelligence of the physicians, new drug discovery, providing preventive and precision medicine, biological extensive data analysis, speeding up processes, data storage and access for health organizations. However, this field of science faces various ethical and legal challenges. Despite tremendous strides made in the field of AI in communities, and its role in improving the treatment process, it is not accessible to all societies. Many low-income and developing countries still do not have access to the latest technologies. It should be noted that the ethical dilemmas, privacy and data protection, informed consent, social gaps, medical consultation, empathy, and sympathy are various challenges that we face in using AI. Therefore, before integrating artificial intelligence with the healthcare system, practitioners and specialists should consider all four medical ethics principles, including autonomy, beneficence, nonmaleficence, and justice in all aspects of health care ([2–6]) ([Fig. 1]) ([7], [8]).

## Medical Consultation, Empathy, and Sympathy

Integrating artificial intelligence (AI) with all areas of health care seems difficult and impossible. Due to uniquely human emotions, human and medical robots might not evolve together in a short time. Physicians and other care providers should seek consultation from or provide consultation to their colleagues, which is not possible in autonomous (robotic) systems. On the other hand, it seems unlikely that patients will accept "machine-human" medical relations instead of "human-human." Doctors and nurses are expected to provide treatment in an empathetic and compassionate environment, which will significantly affect the healing process of patients. This will not be achieved with robotic physicians and nurses. Patients will lose empathy, kindness, and appropriate behavior when dealing with robotic physicians and nurses because these robots do not possess human attributes such as compassion. This is one of the most significant negative aspects of artificial intelligence in medical science. For instance:

- In Obstetrics and Gynecology, any clinical examination requires a sense of compassion and empathy, which will not be achieved with robotic doctors.
- Children usually experience fear or anxiety as they engage in healthcare settings and meet professionals. Their behavioral manifestations are lack of cooperation, withdrawal, and aggression that could be uncontrollable with the new robotic medicine system.
- The use of medical robots in psychiatric hospitals may adversely affect patients who have severe psychiatric disorders. ([Fig. 2]) ([14])

**WHO guidance on the ethics and governance of AI for health,**

**The 6 core principles identified by WHO are:**

1) protect autonomy;

2) promote human well-being, human safety, and the public interest;

3) ensure transparency, explainability, and intelligibility;

4) foster responsibility and accountability;

5) ensure inclusiveness and equity;

6) promote AI that is responsive and sustainable

- ✓ Artificial intelligence beats doctors at diagnosing disease

- ✓ hinting at the possibility that algorithms may one day take the place of physicians

But instead of pitting AI against human experts, what we should really be focusing on is **how they complement each other's strengths in the diagnostic process**

AI & Robotics in Healthcare :
A Challenge in Ethics & Laws

THANK YOU

THANK YOU